

The effect of misalignment of CEO risk tolerance and corporate governance structures on firm performance

Abstract

To explore the link between corporate governance and performance, we examine whether the misalignment of CEO risk tolerance (based on an index constructed from personal traits) and governance structures affects company performance. Utilizing the IBM Watson Personality Insights service to analyze verbal communication by the most senior executives of large US companies to obtain their fundamental Big Five personality traits, our study proposes two hypotheses: First, CEO risk tolerance and corporate governance structures are associated, and second, misalignment of these structures with risk tolerance negatively affects financial performance. We use a large sample of over 8,000 firm-year observations and a two-stage contingency approach suggested by Ittner and Larcker (2001) to test our hypotheses. Our findings are consistent with our misalignment–CEO risk tolerance predictions and support upper echelons theory in the corporate governance setting.

JEL Codes: G41, G30, M12, M42

Keywords: CEO Personality, Big Five, Corporate Governance, Performance

1. Introduction

Corporate governance structures, used for direction and control purposes, have been the subject of discussion by practitioners, academics and regulators. Some consensus has emerged regarding what constitutes good governance (Tingle 2017), and various guidelines have been implemented to enhance effective corporate governance and management practices (OECD 2004). However, survey studies suggest that, at best, mixed evidence supports the hypothesis that better corporate governance results in improved firm performance (Tingle 2017). The lack of support for this hypothesis has been attributed to the great variance in board composition among firms and the largely unknown determinants of governance structures. The existing literature offers a range of plausible explanations for the disparate findings. For example, studies suggest that corporate financial performance is affected by multiple factors simultaneously; that board independence and the lack of frequent board meetings are unlikely to sustain any meaningful influence over corporate performance; and that the enactment and maturation of the Sarbanes-Oxley Act (SOX) of 2002 may partially explain mixed results. To better understand the link between corporate governance and performance, we examine how the misalignment of CEO risk tolerance (based on a combination of personal traits) and governance structures affects company performance.

According to upper echelons theory, experiences, values and personalities greatly influence executives' interpretations of the situations they face and, in turn, affect their choices (Hambrick 2007; Gerstner et al. 2013). Recent evidence (Plöckinger et al. 2016) indicates that executives' behavioral traits affect corporate financial policies approved by the board, such as those relating to capital structure, financing, compensation packages, investment management style and long-term firm survival. Our investigation of the effect of CEO risk tolerance and

governance structure misalignment on performance relies on a contingency approach (Bruns and Waterhouse 1975; Waterhouse and Tiesen 1978) and upper echelons theory. Following Ittner and Larcker's (2001) suggestion, we measure risk tolerance–governance structure misalignment based on the degree to which the observed configurations deviate from the “optimal” configurations for a given risk tolerance level, as indicated by the residual of each observation.

We employ linguistic analytics software to analyze the verbal communication content of senior executives and infer their personality characteristics along five primary personality dimensions (Big Five, mnemonic OCEAN): a) openness (the extent to which a person is open to experiencing a variety of activities); b) conscientiousness (the tendency to act in an organized or thoughtful way); c) extraversion (the tendency to seek stimulation in the company of others); d) agreeableness (the tendency to be compassionate and cooperative toward others); and e) neuroticism (the extent to which a person's emotions are sensitive to his/her environment). Given that any individual is the sum of his/her personality traits, we construct a composite index of the five traits (labeled as risk tolerance by Hrazdil et al. 2019) to gauge the misalignment of CEO risk tolerance to governance structures. These results in turn become the input of a second stage that examines how the misalignment of CEO risk tolerance and governance structures affects performance. To our knowledge, this study is the first to use these objectively assessed personal characteristics to provide new insights into whether and how this misalignment helps explain firm performance.

Employing linguistic analytics software (IBM Personality Insights service; hereafter IBM Watson) to infer personality profiles of senior executives (chief executive officers, CEOs) of large US firms, this study utilizes these objectively assessed personal characteristics to provide new insights into whether and how the misalignment of CEOs' combination of

personality traits (i.e., risk tolerance) and governance structures explain firms' performance. In a multivariate setting, we find that CEOs are less risk tolerant when they serve as board chairs on the boards with more of independent directors. In terms of diversity, we find although female CEOs are not less risk tolerant than their male counterparts, ethnically diverse boards are positively associated with CEO risk tolerance. More importantly, our findings indicate that misalignment between CEO risk tolerance and firm governance structures negatively affects firm performance, as measured by return on assets and return on equity.

Our study makes several contributions to the literature. A major contribution of our study is our departure from the traditional one-dimensional analysis of corporate governance and firm financial performance, which results from our use of a risk tolerance index based on the IBM Watson-derived Big Five personality traits of CEOs that permits us to study how misalignment of governance structures affects performance. Second, we establish that our proxy for inherent risk tolerance is associated with risk-taking actions by CEOs. Specifically, we follow Cain and McKeon (2016), who find evidence that CEOs who possess private pilot licenses are associated with riskier firms, and show that CEO pilots are more risk tolerant than non-pilots. Third, we apply a contingency approach that allows us to extend the existing literature that has explored the relationship between corporate governance and performance but has not included the effect of CEO risk tolerance. Finally, we believe that our results contribute to the evidence on the roles of board diversity and the independence of board members as corporate governance structures.

The remainder of our paper is organized into four sections. The second section situates our paper within the literature, providing context and leading to our hypotheses. The third section provides details of our sample and research methods. We follow this with a section outlining our

results and presenting our findings. The final section provides conclusions, limitations and future research directions.

2. Literature and hypotheses

Corporate governance, the system by which companies are directed and controlled, has drawn the attention of practitioners, academics and policy makers in terms of designing and improving effective governance and management policies. Prior literature has largely investigated the association between effective governance mechanisms and firm performance; however, this literature has been unable to achieve uniform support for the hypothesis that better corporate governance results in improved firm performance. This lack of consensus motivates us to investigate this phenomenon further. To provide context, we summarize some of the prior literature in two areas: corporate governance and firm performance, and CEO personality.

Prior literature on corporate governance and firm performance

Daily et al. (2003) and Adams et al. (2010) survey both theoretical and empirical evidence on corporate governance and firm performance and suggest that there is, at best, mixed evidence in support of the hypothesis that better corporate governance results in improved financial performance. The lack of support for this hypothesis has been attributed to the facts that board composition varies across firms (Coles et al. 2008) and that determination of governance structures remains largely unknown (Boone et al. 2007).¹ The existing literature offers a range of

¹ Despite the studies that suggest boards are ineffective, the literature also contains a prominent set of studies concluding that independent boards influence management behavior and affect corporate performance in significant

plausible explanations for the disparate findings. For example, studies suggest that corporate financial performance is affected by multiple factors simultaneously; that board independence and the lack of frequent board meetings are unlikely to sustain any meaningful influence over corporate performance; and that mixed results occur because of the enactment and maturation of the Sarbanes-Oxley Act (SOX) of 2002 (Hermalin and Weisbach 2003; Useem 2006; Linck et al. 2009).

More recent literature offers additional insights into the determinants of board structures and governance and calls for the consideration of potential unintended consequences of ‘effective’ board composition and leadership strategies (Finkelstein et al. 2009). For example, Goel and Thakor (2008) develop a model that shows that an overconfident manager who sometimes makes value-destroying investments has a higher likelihood than a rational manager of being deliberately promoted to CEO under value-maximizing corporate governance and that the board fires both excessively diffident and excessively overconfident CEOs. Others, such as Del Brio et al. (2013), use social exchange theory to provide evidence that board members’ perceptions of the CEO’s ability, benevolence, and integrity have different effects on board members’ resource provision and monitoring. Additionally, Peteghem et al. (2018) show how a board’s diversity structure can give rise to the formation of subgroups along fault lines, where the resulting subgroup formation may reduce board effectiveness. Recognizing the board-executive dynamics and considering that top management is charged with leading the organization, scholars have recently suggested that executives’ psychological makeup or the

ways. For example, Pearce and Zahra (1991) and Stearns and Mizruchi (1993) suggest that proactive boards are associated with strong financial performance.

composition of the inner circle of executives can play a relevant role in influencing organizational effectiveness and firm performance (Abatecola et al. 2013; Colbert et al. 2014).²

Prior literature on personality characteristics

In their pioneering work, Hambrick and Mason (1984, p. 193) define organizational outcomes as the “reflections of the values and cognitive bases of powerful actors” (i.e., the ‘upper echelons’) in organizations. According to upper echelons theory, experiences, values and personalities greatly influence executives’ interpretations of the situations they face and, in turn, affect their strategic choices and organizational effectiveness (Hambrick 2007).

Personality psychology studies personality and its variation among individuals (Judge et al. 2002) and has been employed in the accounting and management literature. Plöckinger et al. (2016) review sixty studies that analyze the effect of upper echelons and/or executive characteristics on financial accounting choices. The results suggest that top management executives, overseen by a board, exert a significant influence on financial reporting decisions, supporting upper echelons theory predictions. For example, recent studies relate behavioral traits of executives to corporate financial policies approved by the board, such as those relating to capital structure (Hackbarth 2008), financing (Malmendier et al. 2011), compensation packages (Graham et al. 2013), investment management style (Mayfield et al. 2008) and long-term firm survival (Ciavarella et al. 2004). Second, the management literature investigates what personality traits make CEOs more effective leaders. For example, Zhu and Chen (2015) find that narcissistic CEOs exhibit strengths as well as weaknesses that often create considerable controversy about their leadership; Ham et al. (2017) show that a CEO’s narcissistic personality

² Abatecola et al. (2013) and Colbert et al. (2014) provide detailed literature reviews on this topic.

predicts misreporting behavior; and Chatterjee and Pollock (2017) study how a narcissistic CEO affects governance structures and the acquisition of social approval benefits. Giberson et al. (2009) find that CEOs' personality traits affect their organizations' overall cultural values, resulting in impacts on the organizations' norms surrounding acceptable behaviors, including decision making and interpersonal interactions. Psychological factors are, however, difficult to measure in empirical research, and findings are difficult to generalize given the small number of observations researchers often utilize (Plöckinger et al. 2016). To avoid problems with measurement error, sample size or subjectivity in assessment, prior studies use CEOs' personal demographic variables, such as age, gender, tenure, education, sole earner status, and experience (Hambrick and Mason 1984).

The relationship between the CEO and the board has long been a major issue in corporate governance research. While prior studies have shown how powerful CEOs manage the relationship by selecting new directors who are demographically similar to them or who have served on other passive boards (Westphal and Zajac 1995; 1996), little theoretical or empirical research has examined the role of CEOs' personalities in influencing new director selection decisions and the subsequent CEO-board relationship. Specifically, although reducing the uncertainty whether new directors will support the CEO's leadership is often a major concern of the CEO (Westphal and Zajac 1995), we do not know whether and what types of CEOs reduce this uncertainty by selecting more or less independent board members.

Prior literature provides extensive evidence on the determinants of corporate board size and composition. For example, Boone et al. (2007) test the negotiation hypothesis (based on work by Hermalin and Weisbach 1998; Baker and Gompers 2003), which argues that corporate boards reflect the outcome of a negotiation between the CEO and outside board members. The

authors find that board size and independence increase as firms grow and diversify over time, that board size reflects a tradeoff between firm-specific benefits and the costs of monitoring, and that board independence is negatively related to the manager's influence. Others, such as Graham et al. (2017), find that in the year that a new CEO is hired, board independence increases significantly, consistent with the view that new CEOs have less bargaining power initially. The authors also find that as the CEO's tenure (and power) increases, an additional year on the job is associated with a significant decline in board independence, an increase in the probability that the CEO holds the board chair title and an increase in compensation. Finally, prior literature introduces personality theories to corporate governance research on director selection. For example, recent literature provides some evidence on why CEOs favor new directors who are similar to them in their narcissistic tendency or have prior experience with other similarly narcissistic CEOs (Zhu and Chen 2015).

Plöckinger et al. (2016) identify a gap in the prior literature, calling for additional research to clarify the influence of unexamined upper echelon characteristics, important moderator variables, and adverse selection effects in different settings. Further studies of behavioral and psychological characteristics would therefore be beneficial for upper echelons research. Apart from proxies derived from archival sources, directly measured psychological characteristics would provide opportunities to delve into the process of strategic decision making under conditions of bounded rationality, which is the basis of the upper echelons perspective. Plöckinger et al. (2016) suggest that a suitable approach for collecting psychographic profiles of executives could be the usage of established frameworks, such the Big Five personality traits of openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism

(OCEAN). The limitations in measuring psychological characteristics and the recent call for deeper analysis of psychographic profiles of executives motivate our research.

A well-accepted theory of psychology- and social-related fields is that human language reflects personality, thinking style, social connections, and emotional states. The frequency with which we use certain categories of words can provide clues regarding these characteristics. Several researchers have found that variations in word usage in writings such as blogs, essays, and tweets can predict aspects of personality (Fast and Funder 2008; Yarkoni 2010), but none have utilized personality characteristics in large sample settings.

A central tenet of the strategic leadership literature is that organizations are reflections of top executives' unique backgrounds and personalities (Finkelstein et al. 2009). One of the key points of the upper echelons perspective is Hambrick and Mason's (1984) premise that corporate strategic choices and decision outcomes can be predicted by individual managerial characteristics and idiosyncrasies. Based on this premise, the upper echelons perspective proposes that the experiences, values, and personalities of firms' CEOs shape their interpretation of the environment, which in turn influences strategic choices and organizational effectiveness (Hambrick 2007). This leads to our research question: Does misalignment between CEO personality and governance structures affect company performance?

Colbert et al. (2014) provide a detailed literature review on how personality traits are theoretically associated with firm financial performance. For example, according to DeRue et al. (2011), the personality traits of leaders are often seen as either task oriented (conscientiousness, neuroticism, and openness) or interpersonally oriented (extraversion and agreeableness). Among the task-oriented personality traits, conscientiousness describes executives who are persistent, disciplined, and achievement-oriented individuals; this trait relates to performance outcomes in

any job. Similarly, high neuroticism refers to emotionally stable executives who are neither prone to insecurity nor overly anxious or distracted from their work and are therefore also better performers. Finally, openness to experience has been found to predict individual performance in individual leadership effectiveness, as individuals with this trait are more flexible and adaptable as well as more creative and innovative (Judge et al. 2002). In addition to these task-oriented traits, Judge et al. (2002) show that extraversion is the single best personality predictor of leadership. Consequently, executives who exhibit more social influence and have greater energy are expected to be more influential, which should lead to a higher level of organizational performance. In contrast, high agreeableness (i.e., tendency of being modest and having a need for affiliation) has not been found to contribute to success as a leader (Judge et al. 2002) since the devil's advocate role is part of leadership.

While relying on upper echelons theory to highlight the influence of CEO personality traits, we employ a contingency approach (Bruns and Waterhouse 1975; Waterhouse and Tiesen 1978) to investigate the performance implications of alignment between CEO traits and a firm's governance structures. This approach is based on the premise that there are no universally appropriate governance structures that apply equally well to all organizations in all circumstances. To be effective, governance structures must be matched to contextual variables such as CEO traits and other firm characteristics (e.g., size, leverage).

Upper echelons theory indicates that the CEO's (or the top management team's) personality and background traits influence organizational performance (Hambrick and Mason 1984; Hambrick 2007). From the literature, we observe separate examinations with respect to CEO traits and governance (e.g., Zhu and Chen 2015; Chatterjee and Pollock 2017) and CEO traits and aspects of financial performance (e.g., Hackbarth 2008; Malmendier et al. 2011). Our

approach examines how the misalignment of CEO personality and corporate governance structures affects financial performance, thereby contributing to the literature. We examine this relationship using firm financial performance [i.e., return on assets (ROA) and return on common equity (ROE)], indicators of organizational effectiveness that are the most commonly used organizational performance measures in the upper echelons literature (Colbert et al. 2014).

We propose that a good fit (or alignment) between a CEO's personality and governance structure has a positive impact on performance. Given the evidence that personality can substantially influence an individual's relationships with others (e.g., Colbert et al. 2014), we extend the upper echelons perspective on how CEO personality traits and different corporate governance structures help to explain firm financial performance. The existence of a wide variety of corporate governance structures has been discussed in the literature (e.g., Luo and Salterio 2014). Instead of employing all or most of these structures, our approach focuses on a few that are recognized as "best practices" (Kent et al. 2016; Tingle 2017) or have been found in previous research to affect firm performance. In particular, our "best practices" relate to CEO/chair duality (i.e., board chair and CEO are different individuals), the number of independent directors (i.e., independent directors thought to provide better control over a CEO's actions), board diversity (i.e., gender and ethnicity) and board size.

First, CEOs who also occupy the board chair role are thought to have more power and freedom in managing the company (Ghosh et al. 2015). Given this, we expect a CEO who has a high level of risk tolerance to choose riskier projects. However, excessive risk taking may not be beneficial for the company. If duality allows excessive risk taking by the CEO and the board fails to support the CEO's risk taking, we expect a negative association between risk tolerance (based on CEO personality traits) and duality.

Second, the literature provides evidence that independent (outside) directors are more effective than inside directors in monitoring management in terms of risky behaviors such as earnings management (Cornett et al. 2009; Garcia-Meca and Sánchez-Ballesta 2009). CEOs with high levels of risk tolerance might choose to invest in activities that are excessively risky if there are few (or no) independent directors controlling this behavior. To mitigate the negative effect of an overconfident CEO undertaking excessively risky investments, companies need more effective monitoring from independent directors. Hence, we expect a positive association between CEO risk tolerance and board independence.

Third, with more calls for board diversity (e.g., Barsamian et al. 2017), we examine the presence of females and the ethnicity of directors on boards. The evidence regarding female directors' influence on corporate performance has been mixed. For example, Chapple and Humphries (2014) find that the presence of female board members has no significant influence on financial performance, and Sila et al. (2016) find no relationship between gender diversity and firm equity risk. However, other researchers find positive relationships between an increase in female board members and economic performance (Reguera-Alvarado et al. 2017) and an indirect relationship between the number of women on boards and corporate social responsibility performance (Galbreath 2018). What we examine is the relationship between females, who in some contexts have been found to be less risk averse than males (e.g., Byrnes et al. 1999; Olsen and Cox 2001), on the board and CEOs' risk tolerance. Where female board members exist, a mismatch between the board and the CEO in terms of risk seeking may or may not exist given the above evidence, and therefore, the sign of the relationship is difficult to predict.

Ethnic diversity on boards has also received attention in the literature. Some research examines board ethnicity in conjunction with gender diversity, making it difficult to isolate the

specific effect of board ethnicity on performance. Examples of combining the study of gender and the study of ethnic board diversity include examinations of financial performance (Erhardt et al. 2003), corporate communication opacity (Upadhyay and Zeng 2014), and market valuation (Ntim 2015). These studies find positive associations with firm financial performance, more transparency in corporate communications and firm market valuation, respectively. Two studies explicitly examine ethnic (or minority) diversity as a separate variable. Carter et al. (2003) find that ethnically diverse boards are positively related to firm value. Bravo et al. (2018) find that boards' ethnic diversity affects risk-related information disclosure, which leads to a lower cost of capital. Given these results, the associated sign between board ethnic diversity and CEO risk taking is difficult to predict. While increased financial performance may result from increased CEO risk taking and be positively associated with more ethnically diverse board members, increased risk-related disclosures may actually be associated with lower CEO risk tolerance.

Finally, large board size has generally been found to produce negative relationships with companies' market value (Yermack 1996) and financial performance in different contexts, such as active takeover markets (Cheng et al. 2008), small and medium-sized companies (Bennedsen et al. 2008), large or global firms (Guest 2009; Malik and Makhdoom 2016), and the Canadian setting (Amar et al. 2011). In our study, we explore the relationship between the CEO's risk tolerance and board size. Given the previous evidence, we expect that larger boards are negatively related to CEO risk taking. We test our research question using two hypotheses. Stated formally:

H₁: CEO risk tolerance, based on OCEAN personality traits, is associated with corporate governance structures.

H₂: Misalignment of CEO risk tolerance and governance structures is negatively associated with firm performance.

The research producing mixed evidence on whether governance impacts an organization's financial performance has generally been conducted without considering the direct influence of the CEO's personality traits. Our study uses financial performance indicators, generally recognized as the responsibility of top management and especially the CEO, to examine whether the CEO's combined traits influence this performance.

3. Sample and methodology

IBM Watson analyzes verbal communication content that people send, infers portraits of individuals that reflect their personality characteristics, and returns a personality profile of the author of the input.³ We utilize this linguistic analytics software to infer individuals' intrinsic personality characteristics, needs and values from publicly available transcribed conference calls related to firms' fiscal year-end performance. We specifically focus on the question and answer (Q&A) period of the conference calls related to year-end earnings announcements because of the importance of these calls as a voluntary disclosure mechanism (Davis et al. 2015). The unstructured and unregulated nature of the Q&A period provides a unique opportunity for

³ IBM conducted a validation study to understand the accuracy of the service's approach to inferring a personality profile. IBM collected survey responses and Twitter feeds from 1,500 to 2,000 participants for all characteristics and languages. The results place the service at the cutting edge of personality inference from textual data, as indicated by Schwartz et al. (2013) and Plank and Hovy (2015).

managers to reflect their verbalized opinions on questions posed by analysts, which provides a standardized setting for collecting executives' personality profiles. By focusing only on conference calls related to earnings announcements, we also control for the underlying economic news communicated in the disclosure (i.e., earnings surprise). We specifically utilize CEOs' responses to questions raised by analysts during year-end conference calls as inputs to IBM Watson.

Our sample data originate from five sources: (1) compensation committee structures, board composition, director profiles, CEOs directors' current and past appointments and activities from BoardEx (North American Region); (2) stock return data from the Center for Research in Security Prices (CRSP) daily return files; (3) book-to-market ratio, firm size, and other financial variables from annual Compustat files; and (4) Big Five personality traits from the IBM Watson. We manually searched proxy statements to obtain variables related to board independence (i.e., CEO duality, insider/outsider, audit committee independence and board capital – the capability of board members based on their social status) and to verify the names of CEOs and board chairs. Using the sources described above, we gathered our data for the years 2002 through 2013. The data requirements resulted in a sample of 8,208 firm-year observations. The distribution of our sample by year is shown in Table 1.

[Insert Table 1 about here]

In our study, we depart from the traditional one-dimensional analysis of the relationship between corporate governance and firm financial performance by utilizing the verbal communication of CEOs of large US companies to identify their fundamental Big Five

personality traits.⁴ The Big Five, developed by Norman (1963) and Costa and McCrae (1992), is one of the best studied and most widely used personality models to describe how a person generally engages with the world. The dimensions are often referred to by the mnemonic OCEAN, where ‘O’ stands for *Openness* (the extent to which a person is open to experiencing a variety of activities), ‘C’ for *Conscientiousness* (the tendency to act in an organized or thoughtful way), ‘E’ for *Extraversion* (the tendency to seek stimulation in the company of others), ‘A’ for *Agreeableness* (the tendency to be compassionate and cooperative toward others), and ‘N’ for *Neuroticism* (emotional range, the extent to which a person’s emotions are sensitive to his/her environment).⁵ Specifically, integrating personality and leadership theories with upper echelons

⁴ The Big Five personality traits, also known as the five-factor model (FFM), provide a model based on common language descriptors of personality.

⁵ Toegel and Barsoux (2012) describe leaders along the Big Five personality dimensions as follows: 1) Openness to experience reflects the degree of intellectual curiosity, creativity and a preference for novelty and variety. It also describes the extent to which a person is imaginative or independent and depicts a personal preference for a variety of activities over a strict routine. Moreover, high openness can be perceived as unpredictability or lack of focus, whereas leaders with low openness seek to gain fulfillment through perseverance and are characterized as pragmatic and data driven. 2) Conscientiousness reflects a tendency to be organized and dependable, where highly conscientious leaders show self-discipline, act dutifully, aim for achievement, and prefer planned rather than spontaneous behavior. High conscientiousness is often perceived as stubbornness and obsession, whereas low conscientiousness is associated with flexibility and spontaneity but can also appear as sloppiness and a lack of reliability. 3) Extraversion is associated with high energy, positive emotions, assertiveness, sociability, talkativeness, and the tendency to seek stimulation in the company of others. High extraversion is often perceived as attention seeking and domineering, whereas low extraversion is characterized by a reserved and reflective personality. 4) Agreeableness is a tendency to be compassionate and cooperative rather than suspicious and antagonistic towards others. It also reflects one’s trusting and helpful nature and whether a person is generally good tempered. More agreeable leaders are often perceived as naive or submissive, whereas less agreeable leaders are often competitive or

theory, we examine whether the misalignment between CEOs' personal characteristics and corporate governance structures affects firm financial performance. As noted, our focus relates to recent evidence that behavioral traits of executives affect corporate financial policies approved by the board, such as those relating to capital structure, financing, compensation packages, investment management style and long-term firm survival.

To capture CEOs' tolerance for risk, Hrazdil et al. (2019) use Big Five scores to compute an index, *RT*, based on previous research that documents a relatively consistent relationship between the five traits and risk tolerance. Specifically, prior research has found that low agreeableness, low neuroticism, high openness, high extraversion, and low conscientiousness (Costa and McCrae 1997; Clarke and Robertson 2005; Nicholson et al. 2005; Soane and Chmiel 2005; Hong and Paunonen 2009; Gullone and Moore 2000; Nadkarni and Herrmann 2010) are associated with high tolerance of risk. To capture this association, Hrazdil et al. (2019) reverse code and compute the *RT* index based on the personality trait sum, as shown in Equation 1:

$$RT = [O + (100 - C) + E + (100 - A) + (100 - N)] / 5 \quad (1)$$

challenging and can thus be seen as argumentative or untrustworthy. 5) Neuroticism is the tendency to easily experience unpleasant emotions, such as anger, anxiety, depression, and vulnerability. Neuroticism also refers to the degree of emotional stability and impulse control and is sometimes referred to as low 'emotional stability'. A high need for stability manifests itself as a stable and calm personality but can be seen as uninspiring and unconcerned. A low need for stability causes a reactive and excitable personality; these individuals are often very dynamic but can be perceived as unstable or insecure.

Equation 1 follows the approach by Dawes (1979), who demonstrates that linear models (i.e., based on unit or equal weighting) are superior to clinical intuition in predicting a numerical criterion from numerical predictors.⁶ The risk tolerance index relies on research that finds certain important relationships between the OCEAN traits and CEOs' comfort with risk (details provided in Hrazdil et al. 2019).⁷ The key to using the index is to blend the five traits to capture an overall CEO portrait, as prior literature suggests that the Big Five dimensions of personality contribute to predicting performance (Hirsh 2010; Judge et al. 2002).

To verify that our proxy for inherent risk tolerance (RT) captures CEOs' risk-taking actions, we follow Cain and McKeon (2016), who validate that pilot certification is a proxy for personal risk-taking, and test whether CEOs who are certified pilots are more risk tolerant than non-pilots. Following Cain and McKeon, we draw the initial sample of CEOs from the ExecuComp database during 2002-2013, which primarily covers firms in the Standard & Poor's (S&P) 1500 Index. We then obtain pilot information from the FAA online airmen inquiry website, which contains names, certificate levels, and rating information for all registered pilots in the US.⁸ We first search for CEO names; if a given CEO's name does not produce a match in the FAA's database, then we code this observation as a nonpilot and no further validation is necessary. In other cases, using the name alone is not sufficient to identify a CEO, as it is common for other people to have the same name. If a given name produces at least one name

⁶ Dawes (1979) became one of psychology's most cited papers (Fischhoff 2012).

⁷ Hrazdil et al. (2019) provide several validation tests for the Watson PI personality traits based on a large sample of US firms (9,431 firm-year observations during 2002-2013 for CEOs and 8,701 firm-year observations for CFOs, respectively) and demonstrate that firm-level executive personality traits (OCEAN and RT) are manager specific, unrelated to firm characteristics, and that executive risk tolerance varies with existing inherent and behavioral-based measures in predictable ways.

⁸ Available at <https://amsrvs.registry.faa.gov/airmeninquiry/>.

match in the FAA's database, we then confirm whether the pilot certificate belongs to the sample CEO. We use LexisNexis, Bloomberg, and public records searches to obtain birth dates, home addresses, and other personal information on the CEOs that can be used to validate the FAA certificate information. We then use the CEOs' date of birth in addition to his or her name to identify pilots, as the date of birth does not change over time. The manual data checking results in a final sample of 145 pilot-year CEOs and 4,422 non-pilot years. Our validation test reveals that RT of pilot CEOs is 54.02 compared to 52.48 for non-pilot CEOs. This difference is statistically significant with a p-value of 0.001.

We then examine the effect of firm governance structure and CEO risk tolerance misalignment on performance using the two-stage approach proposed by Ittner and Larcker (2001). Gerdin and Greve (2004) classify this approach as a Cartesian method. We assume that at any given time, a cross-sectional sample is composed of organizations that vary with respect to the optimal level of governance structure (Ittner and Larcker 2001). This assumption is consistent with Milgrom and Roberts' (1992) argument that all organizations may be dynamically learning and moving toward the optimal level, but a cross-sectional sample consists of observations that are distributed around the optimal choice. The observed cross-sectional variation in practices provides a means to assess the performance consequences of CEO risk tolerance and a firm's choice of governance structure.

We follow Meyer and Zucker (1989) and argue that a cross-sectional sample comprises firms that vary with respect to the most suitable level of CEO risk tolerance. In our first stage, the range of possible combinations of governance structure and CEO risk tolerance level is depicted in Equation (2).

$$\begin{aligned}
RT_{it} = & \alpha_0 + \alpha_1 CEODual_{it} + \alpha_2 GenRatio_{it} + \alpha_3 IND_{it} + \alpha_4 BoardSize_{it} + \alpha_5 NAT_{it} + \\
& + \sum \alpha_{it} Controls + FE + \varepsilon
\end{aligned} \tag{2}$$

where *CEODual* is a dummy variable equal to 1 if the CEO is also the board chair and zero otherwise; *GenRat* is the ratio of the number of male directors to the total number of directors on the board; *IND* is the ratio of the number of independent directors to the total number of directors on the board; *BoardSize* is the number of directors on the board; *NAT* is the nationality mix of board members; *Controls* include *SIZE* (log total assets), *LEV* (leverage), *Female* (dummy variable with a value of 1 when the CEO is female and zero otherwise), and *R&D* (R&D intensity equal to R&D expenditures / total assets at the end of the period); and *FE* are year and industry (based on two-digit SIC) fixed effects.

Following Ittner and Larcker (2001), we use Equation 2 (the first stage) to estimate the appropriate benchmark level of CEO risk tolerance for the combination of governance structure variables. This approach assumes that firms, on average, have correctly chosen their CEO based on his/her risk tolerance level and that the estimated models capture the appropriate level of CEO risk tolerance given the firm's governance structure (Van de Vin and Drazin 1985). If the benchmark models represent an optimal CEO risk tolerance level, then any deviations from the estimated models (i.e., either too little or too much risk tolerance) should be negatively associated with firm performance. Ittner and Larcker (2001) propose that the residuals for each observation, whether positive or negative, estimate the distance by which the firm deviates from the "optimal" level of CEO risk tolerance (Equation 1). Hence, the absolute value of the residuals generated from Equation 2 ($|\varepsilon|$) indicates the misfit from the optimal governance structure–CEO risk tolerance configuration.

In our second stage, we regress performance measures (*ROA*, *ROE*) on the absolute value of the residuals to investigate the impact of the CEO risk tolerance–governance structure misfits on performance. Specifically, Equation (3) is used to test this prediction, where the absolute residuals $|\varepsilon_{it}|$ are obtained from Equation (2):

$$PERFORMANCE\ MEASURES_{it} = \gamma_0 + \gamma_1 |\varepsilon_{it}| + v \quad (3)$$

In financial research, accurate measurement of variables is essential for drawing valid statistical inferences from empirical samples. Inaccurately measuring or using noisy proxies and drawing inferences about the significance of personality characteristics for various outcomes can often result in type I errors (observing a difference when none exists) and type II errors (failing to observe a difference when one does exist). Minimizing these errors is not a simple or straightforward issue since for any given sample size, the effort to reduce one type of error generally results in increasing the other. Two ways to minimize both types of errors are to increase the sample size or to provide a better technique for measuring variables. In this study, our ability to analyze a large sample of firm observations (8,208) and objectively assess CEO risk tolerance, based on several personality dimensions, assists us in minimizing both types of errors.

4. Results

Table 2 provides summary statistics for the variables included in Equations 1-3. RT has a range between 13.4 and 77.0 on a scale of 100 with a median of 52. On average, approximately one

third of CEOs are also chairs of the board, and 1% are females. The percentage of directors who are independent is 68%, ranging from 12% to 92%. We measure our gender ratio as males on the board / total number of board members. This gender ratio is 90% male and ranges between 60% and 100%, whereas national diversity on the board is low (8%), ranging between 0 and 60%. The board size of an average company comprises approximately nine directors, ranging between 4 and 16. The ROA average is 2%, whereas the ROE average is 5%.

[Insert Table 2 about here]

Pearson correlations between variables are displayed in Table 3 for RT, board and CEO characteristics, performance and control variables. First, RT is significantly positively correlated with firm performance. Second, RT is significantly positively correlated with IND, BoardSize, Size, and NAT, indicating that the more risk tolerant a CEO, the more likely s/he is to manage a larger firm and to be governed by a larger board that contains more independent directors with more diverse nationalities. RT is significantly negatively correlated with GenRat, indicating that the more risk tolerant a CEO, the less likely s/he is to be governed by a board with a higher percentage of male board members. Finally, the significant negative correlation between RT and R&D intensity signals that a more risk-tolerant CEO engages in lower R&D intensity. We interpret these findings as support for our first hypothesis that CEO risk tolerance, a summary

index of personality traits, is associated with the corporate governance structures examined in this study.⁹

[Insert Table 3 about here]

Table 4 presents the first-stage regression results based on a sample of 8,208 observations. Consistent with our expectations, we find that RT and duality are significantly negatively associated and that CEOs who manage larger firms and who are governed by boards with more independent and more ethnically diverse board members are more risk tolerant than their counterparts in smaller organizations overseen by fewer independent or minority directors. While insignificant, the number of males on the board is negatively associated with RT. Additionally, we find that larger boards are negatively associated with RT; this finding is insignificant but consistent with the literature indicating that larger boards may be ineffective in controlling CEOs' risk taking. While we expect that R&D intensity is positively associated with CEO risk tolerance, the result indicates the opposite. We offer two possible explanations for this result. First, a reexamination of our data shows that the majority of our sampled firms did not report R&D expenditures (the median is zero). Second, most R&D expenditures are treated as current-period expenses, which reduce reported income. Hence, an influential CEO might be inclined to reduce the resources spent on R&D activities in order to maximize short-term reported income. Overall, our results are consistent with our first hypothesis, supporting the premise that a CEO's risk tolerance is associated with corporate governance structures.

⁹ We also use variance inflation factors (VIFs) for all of the variables in our regression models to investigate whether multicollinearity is present in our data. Untabulated results show that all VIFs take values less than 6, which does not indicate the presence of harmful collinearity (Dielman, 2001).

[Insert Table 4 about here]

The second-stage regression results from Equation 3 are reported in Table 5. The variables *ehat* (absolute value of the residuals), *ehat_neg* (negative residuals), and *ehat_pos* (positive residuals) are the residuals from the regression (Equation 2) shown in Table 4 and capture the relationship between CEO risk tolerance and the governance variables taken together, including the control variables. We use these residuals to explain company performance (*ROA*, *ROE*).

Our second hypothesis predicts that misalignment between CEO risk tolerance and a firm's governance structures have a negative impact on firm performance. Table 5 presents the results of the OLS regressions testing the impact of CEO risk tolerance–governance structure misfit on firm performance, as measured by *ROA* and *ROE*. The results indicate that the relationship between misfit (as measured by the absolute residuals ($\text{ehat}, |\varepsilon_{it}|$) and both *ROA* and *ROE*) are negative and significant ($\gamma = -0.00083$, $p < 0.05$ and $\gamma = -0.00126$, $p < 0.10$ for *ROA* and *ROE*, respectively). These results are consistent with our premise that misalignment between CEO risk tolerance and a firm's governance structures has a detrimental effect on performance.

We further follow Ittner and Larcker's (2001) suggestion and test the assumption that the direction of the residuals (positive or negative) has a symmetrical effect on performance. We run a separate regression for the positive (*ehat_pos*) and negative (*ehat_neg*) residuals on performance. As expected, Table 5 shows that the positive residuals are negatively and significantly related to performance ($\gamma = -0.00136$, $p < 0.01$ and $\gamma = -0.00118$, $p < 0.05$ for *ROA* and *ROE*, respectively). As for the negative residuals, although the effects on performance are

positive (as expected) for both ROA and ROE, the coefficients are not statistically significant. These results indicate that excessive CEO risk tolerance (positive residuals) is more damaging than low CEO risk tolerance (negative residuals).

Overall, our results support previous findings that older CEOs are less risk tolerant than younger CEOs (i.e., Vroom and Pahl 1971; Byrnes et al. 1999). Additionally, we find that risk-tolerant male CEOs are employed by companies that have a smaller proportion of male directors on their boards; however, this association is insignificant, suggesting that gender diversity (i.e., females on boards) may not be a necessary control on the CEO's risk taking.¹⁰ This is because male directors may be able to control aggressive risk taking by a CEO even in cases where gender diversity is low or nonexistent, consistent with others' findings (e.g., Sila et al. 2016). Most importantly, we find that for situations where there is a misfit between the risk tolerance of a CEO and the corporate governance structures we examine, there is a negative and significant effect on firm performance (ROA, ROE), as measured by the total and positive residuals. However, while the effect of misalignment between RT and negative residuals is positive (as would be expected), this relationship is not significant.

5. Conclusion and directions for future research

Our paper addresses the research question of whether misalignment between CEO personality and governance structures affects company performance. For the corporate governance structures

¹⁰ Hrazdil et al. (2019) document that female executives are less risk tolerant than male executives; however, this result is primarily driven by a significantly larger proportion of female CFOs relative to female CEOs. In our study, female CEOs represent less than 1% of the whole sample, which is consistent with Hrazdil et al.

that we examine, we find that such misalignment does affect firm performance. To arrive at our findings, we employ a contingency approach and the two-stage regression approach suggested by Ittner and Larcker (2001).

Our paper makes several contributions to the literature. Following Hrazdil et al. (2019), we employ a risk tolerance index based on the OCEAN personality traits of CEOs to study how misalignment of governance structures affects performance. We further validate that our proxy for RT is associated with risk-taking actions by CEOs (proxied by pilot licenses), which has implications for future researchers. Unlike a binary variable (license or no license), and the fact that only a small fraction of CEOs has pilot licenses, RT derived from Big Five traits based on conference call transcripts is continuous and can be measured for most CEOs. Further, to the best of our knowledge, we are the first to use CEO personality traits to examine the effect of misalignment between governance structures and performance. Our application of the contingency and a two-stage regression approach allows us to go beyond existing literature that has explored the relationship between corporate governance and performance but has not included CEO risk tolerance. Finally, we believe that our results provide some interesting findings with respect to board diversity and the independence of board members. While diversity is recommended in terms of both the gender representation and nationalities of directors, our sample indicates that neither women nor minorities comprise a large percentage of board members. However, in terms of controlling a risk-tolerant CEO, male board directors seem to function well in this capacity.

Limitations of empirical studies are common. In our study, despite a large number of observations, there remains the possibility that another sample could produce different results. Furthermore, our sample represents US companies, and a more international sample might

provide additional or new insights. The use of other corporate governance structures may also affect the outcomes. Based on the noted limitations, future research projects might exist. For example, a similar study could use a different sample in an international setting. Other researchers may wish to examine how CEO risk tolerance affects other operational outcomes such as financing or investing activities.

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TABLE 1
Sample

Fiscal Year	Frequency	Percent	Cumulative
2002	201	2.45	2.45
2003	391	4.76	7.21
2004	430	5.24	12.45
2005	519	6.32	18.77
2006	598	7.29	26.06
2007	702	8.55	34.61
2008	803	9.78	44.40
2009	824	10.04	54.43
2010	864	10.53	64.96
2011	976	11.89	76.85
2012	975	11.88	88.73
2013	925	11.27	100.00
Total	8,208	100.00	

This table presents the breakdown of our sample into firm-year observations.

TABLE 2
Summary statistics

Variable	N	Mean	Standard Deviation	Minimum	25 th Percentile	Median	75 th Percentile	Maximum
RT	8,208	51.87	6.28	13.40	48.20	52.00	56.00	77.00
ROA	8,208	0.02	0.14	-0.92	0.01	0.04	0.08	0.34
ROE	8,208	0.05	0.23	-1.27	0.01	0.10	0.17	0.37
CEODual	8,208	0.33	0.47	0.00	0.00	0.00	1.00	1.00
GenRat	8,208	0.90	0.10	0.60	0.85	0.90	1.00	1.00
IND	8,208	0.68	0.13	0.12	0.60	0.71	0.78	0.92
BoardSize	8,208	8.63	2.20	4.00	7.00	8.00	10.00	16.00
NAT	8,208	0.08	0.15	0.00	0.00	0.00	0.10	0.60
SIZE	8,208	6.88	1.79	2.55	5.64	6.79	8.08	11.57
LEV	8,208	0.28	0.25	0.00	0.02	0.26	0.45	0.97
Female	8,208	0.01	0.12	0.00	0.00	0.00	0.00	1.00
R&D	8,208	0.13	0.53	0.00	0.00	0.00	0.07	7.17

The variables are defined as follows. Risk tolerance (RT, an index combining the five OCEAN traits denoted by O [openness]; C [conscientiousness]; E [extraversion]; A [agreeableness]; N [neuroticism], as defined by Equation 1) is based on conference calls during year t ; ROA (return on assets, income before extraordinary items / total assets); ROE (return on equity, income before extraordinary items / shareholder's equity); CEODual (dummy variable with a value of 1 when the CEO is also the chair of the board and zero otherwise); GenRat (number of male board members / number of total board members); IND ([number of independent board directors / total number of board members] x 100); BoardSize (number of directors on a company's board), NAT (nationality mix, defined as the number of directors from different countries / total number of directors); SIZE (natural log of company's total assets); LEV (total debt / total equity); Female (dummy variable with a value of 1 when the CEO is female and zero otherwise); and R&D (research and development expenditures / total assets at end of period). Missing values of Female and NAT have been set to 0, and all variables are winsorized at 1% and 99%, respectively.

TABLE 3
Correlations

Variable		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
ROA	I	1.00											
ROE	II	0.89	1.00										
RT	III	0.07	0.06	1.00									
CEODual	IV	0.18	0.19	0.01	1.00								
GenRatio	V	-0.08	-0.11	-0.03	-0.19	1.00							
IND	VI	0.05	0.08	0.05	0.29	-0.18	1.00						
BoardSize	VII	0.15	0.18	0.05	0.25	-0.37	0.22	1.00					
SIZE	VIII	0.30	0.32	0.14	0.35	-0.31	0.20	0.63	1.00				
LEV	IX	-0.03	0.01	0.00	0.09	-0.10	0.06	0.28	0.44	1.00			
Female	X	0.03	0.04	0.00	0.02	-0.19	0.06	0.05	0.06	0.03	1.00		
NAT	XI	-0.03	-0.02	0.09	-0.01	-0.04	-0.05	0.16	0.16	0.01	0.01	1.00	
R&D	XII	-0.50	-0.27	-0.06	-0.12	0.02	0.00	-0.10	-0.23	-0.14	-0.02	0.06	1.00

Pearson correlations that are significant at the 5% level are in bold. All variables are defined in Table 2.

TABLE 4
Regression results – First stage

Dependent variable	RT
CEODual	-0.807** [-2.45]
GenRatio	-1.382 [-0.88]
IND	1.549*** [10.15]
BoardSize	-0.129 [-1.61]
NAT	2.311** [2.40]
SIZE	0.870*** [10.15]
LEV	-0.635 [-1.24]
Female	-0.561 [-1.04]
R&D	-0.369** [-2.34]
Constant	46.870*** [25.29]
N	8,208
Adjusted R ²	0.109

Regression results are based on Equation 2 and include year and industry fixed effects. All variables are defined in Table 2. Robust standard errors are reported in [parentheses]. ***, **, and * denote significance at $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

TABLE 5
Regression results – Second stage

	ROA Absolute value of residuals	ROA Negative residuals	ROA Positive residuals	ROE Absolute value of residuals	ROE Negative residuals	ROE Positive residuals
ehat (x 10 ²)	-0.083** [0.045]			-0.126* [0.085]		
ehat_neg (x 10 ²)		0.050 [0.304]			0.107 [0.257]	
ehat_pos (x 10 ²)			-0.136*** [0.007]			-0.118** [0.048]
N	8,208	3,917	4,291	8,208	3,917	4,291
Adjusted R ²	0.082	0.094	0.069	0.083	0.097	0.070

Regression results are based on Equation 3 and include year and industry fixed effects. The variables ehat (absolute value of residuals), ehat_neg (negative residuals), and ehat_pos (positive residuals) are the residuals from the regression shown in Table 4 and capture the relationship between CEO risk tolerance and the governance variables grouped together. All remaining variables are defined in Table 2. Robust standard errors are reported in [parentheses]. ***, **, and * denote significance at $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.